ECEN 250 Lab5 – Mutual Inductance

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Purposes:

- Learn how to simulate magnetically coupled inductors
- Use lab equipment to evaluate the magnetically coupled windings of an audio transformer
- Make observations on the impact of mutual inductance in a magnetically coupled inductor circuit

Procedure:

Part 1a - SPICE simulation of a magnetically coupled two-inductor RL circuit

Simulate the following circuit in LTspice:

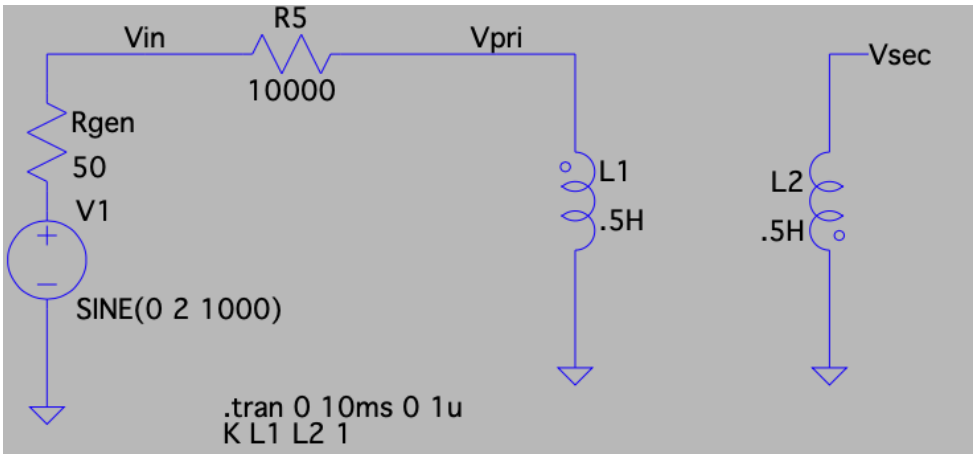
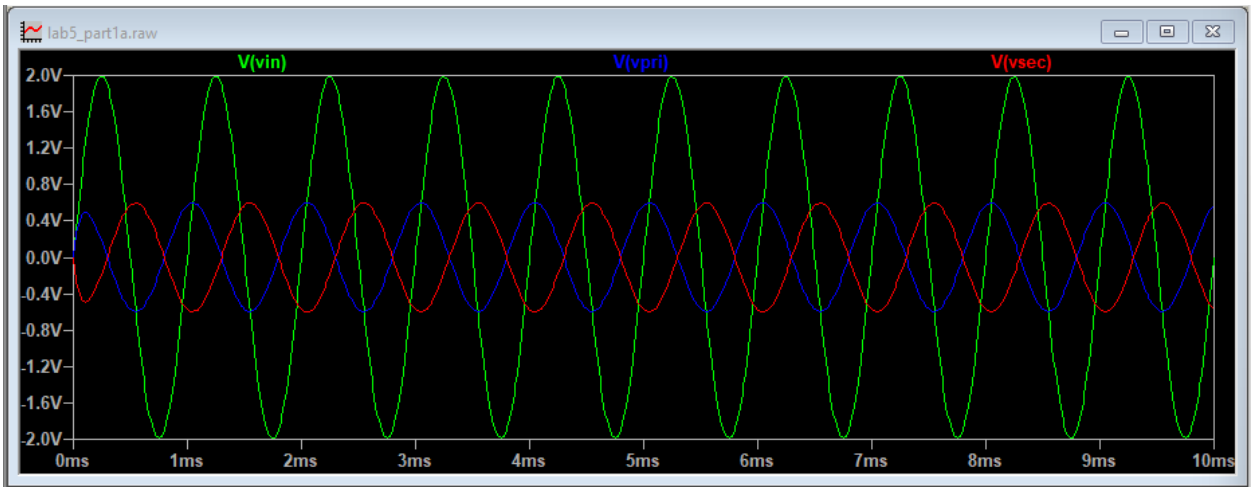


Figure 1a - A SPICE schematic of an RC circuit with a sine wave

The command "K L1 L2 1" magnetically couples L1 and L2 with a coefficient of coupling magnitude of 1 (100% of the field is coupled between coils).

Calculate the mutual inductance:_____0.5 H_____

Place a screenshot of your simulation below (display Vin, Vpri, and Vsec):



Repeat the simulation with a square wave input as shown:

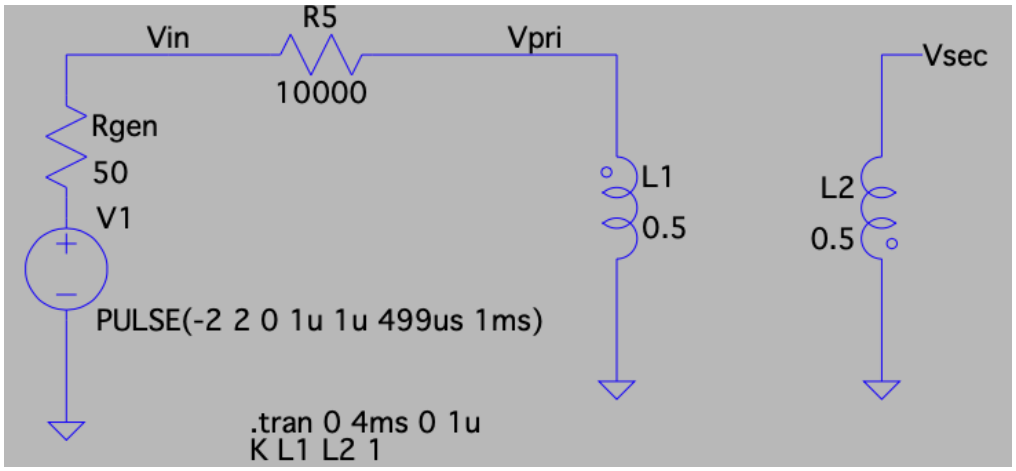
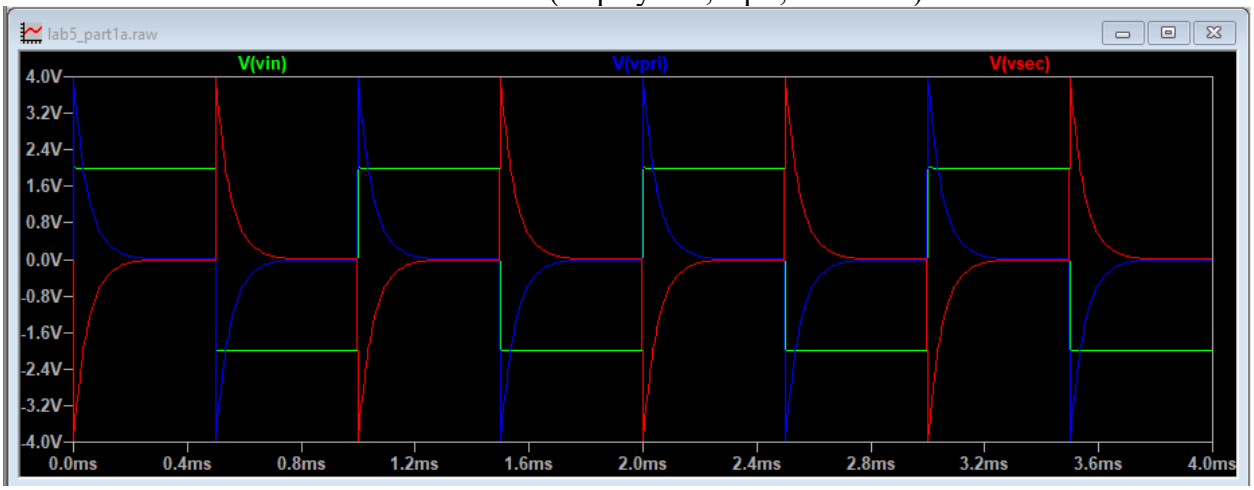


Figure 1b - A SPICE schematic of an RC circuit with a square wave

Place a screenshot of the simulation below(display Vin, Vpri, and Vsec):



How much time does it take for the Vpri signal to decay from its maximum value to e^{-1} of its maximum value?_____0.02 ms_____

How can the above time be used to calculate the value of the inductance if you only know the resistor value? __inductance can be found by multiplying the time by the resistance_____

What is the calculated inductance? _____0.2 H_____

Part 2 - Simulation of series-connected magnetically coupled inductors

Simulate the following circuit in LTspice:

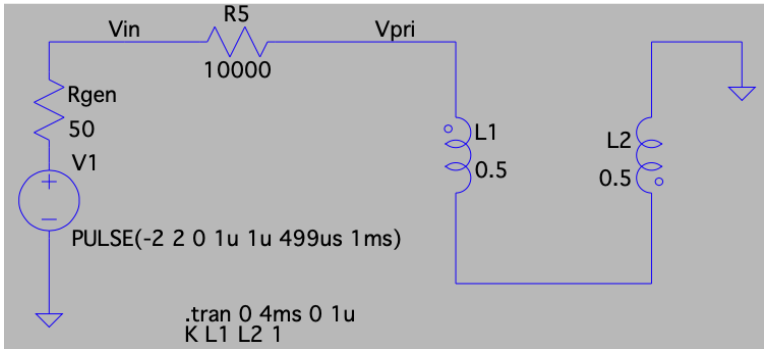
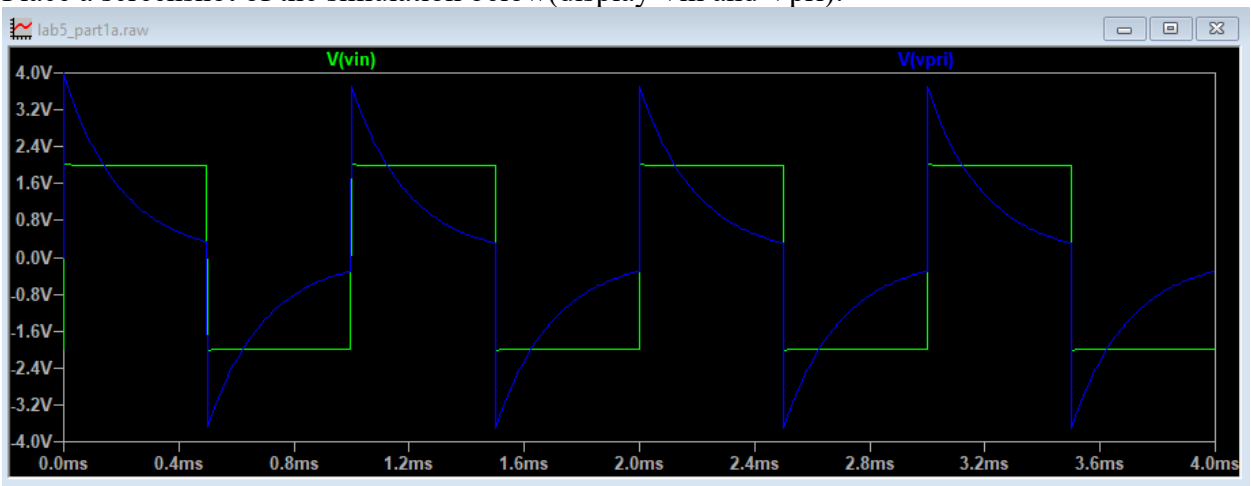


Figure 2a - A schematic of series-connected magnetically coupled inductors

Place a screenshot of the simulation below(display Vin and Vpri):



What happened to Vpri?___The rate of voltage changes are much more gradual
_____

Calculate the total inductance of this series circuit by measuring the time it takes for Vpri to reach $e^{-1}$of its peak value:_____2 H_____

Simulate the following circuit in LTspice:

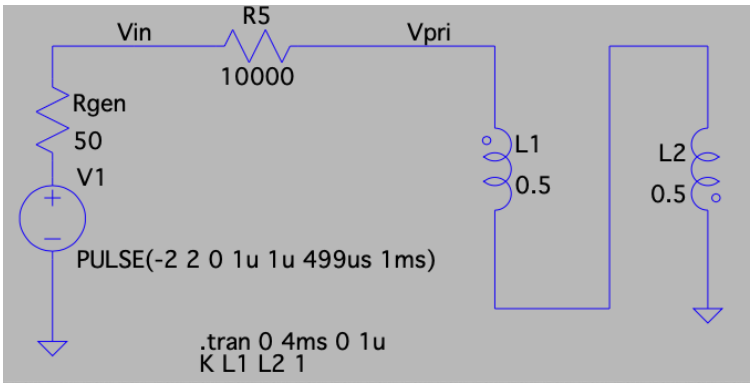
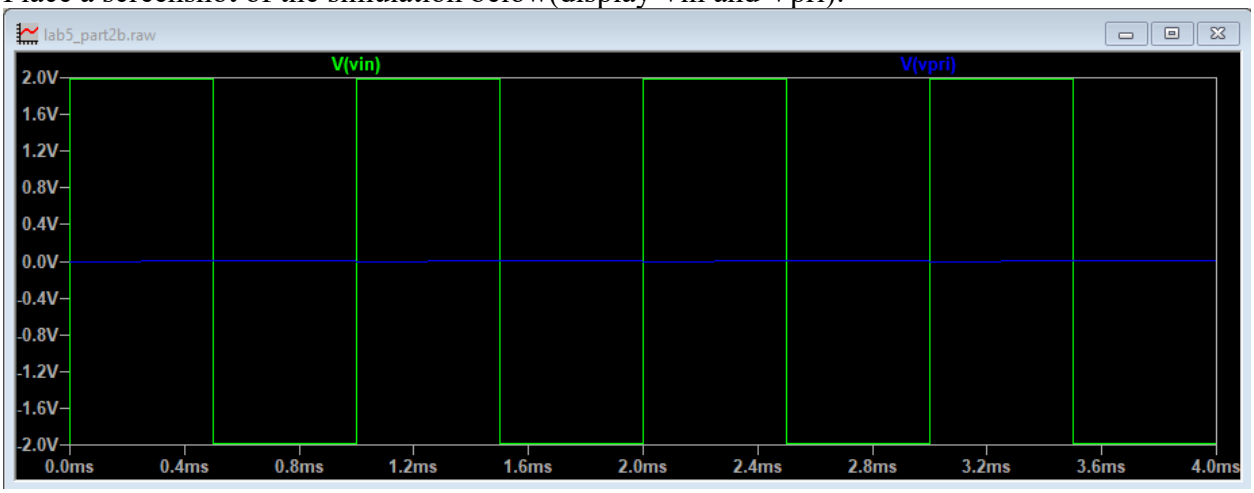


Figure 2b - A second schematic of series-connected magnetically coupled inductors

Place a screenshot of the simulation below(display Vin and Vpri):



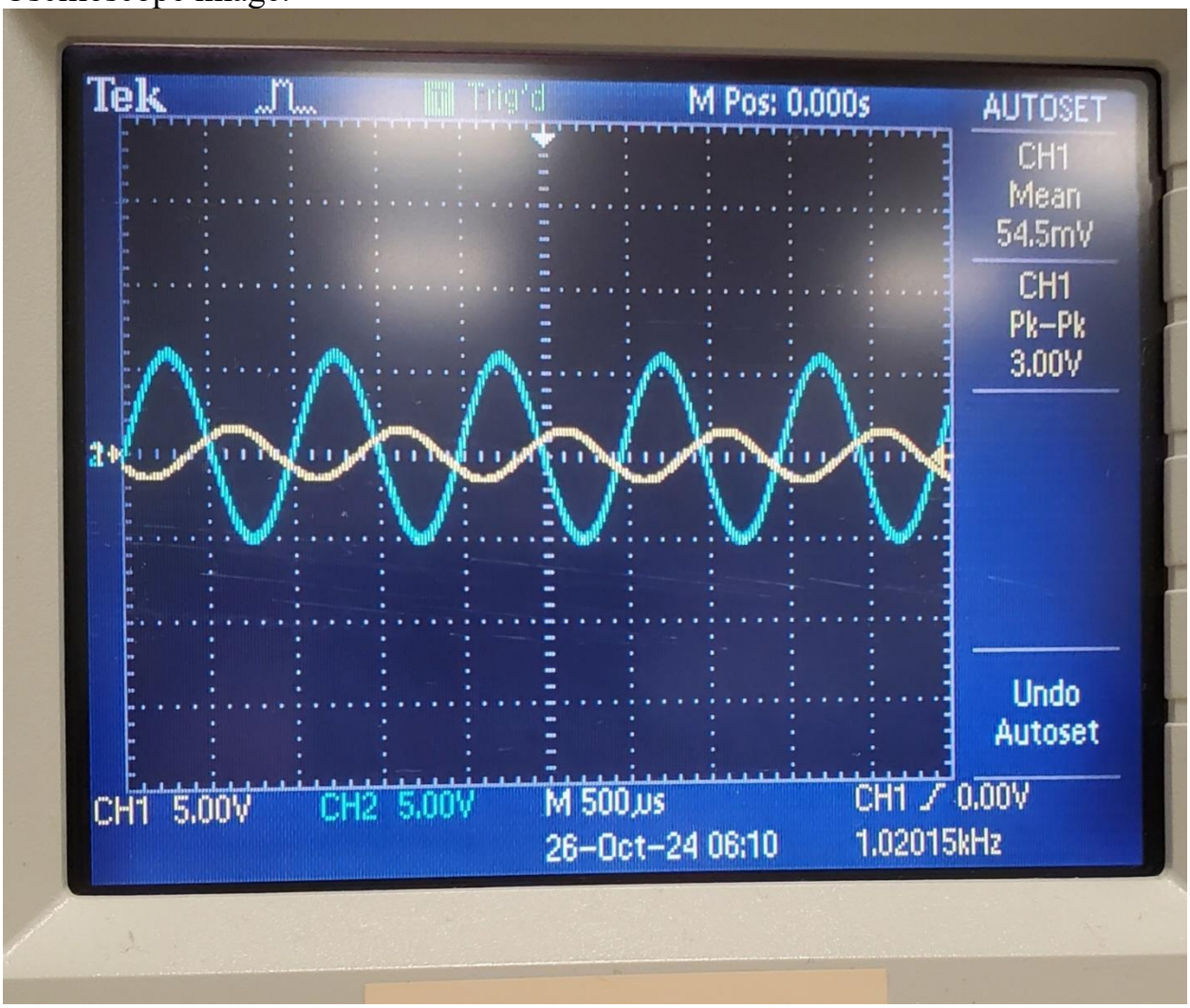
What happened to Vpri?____its connected straight to ground which is a constant 0V because the inductors cancelled eachother out_____

Calculate the total inductance of this series circuit by measuring the time it takes for Vpri to reach e^{-1} of its peak value:_____0 H_____

Part 3 - Construct the physical circuit and make measurements

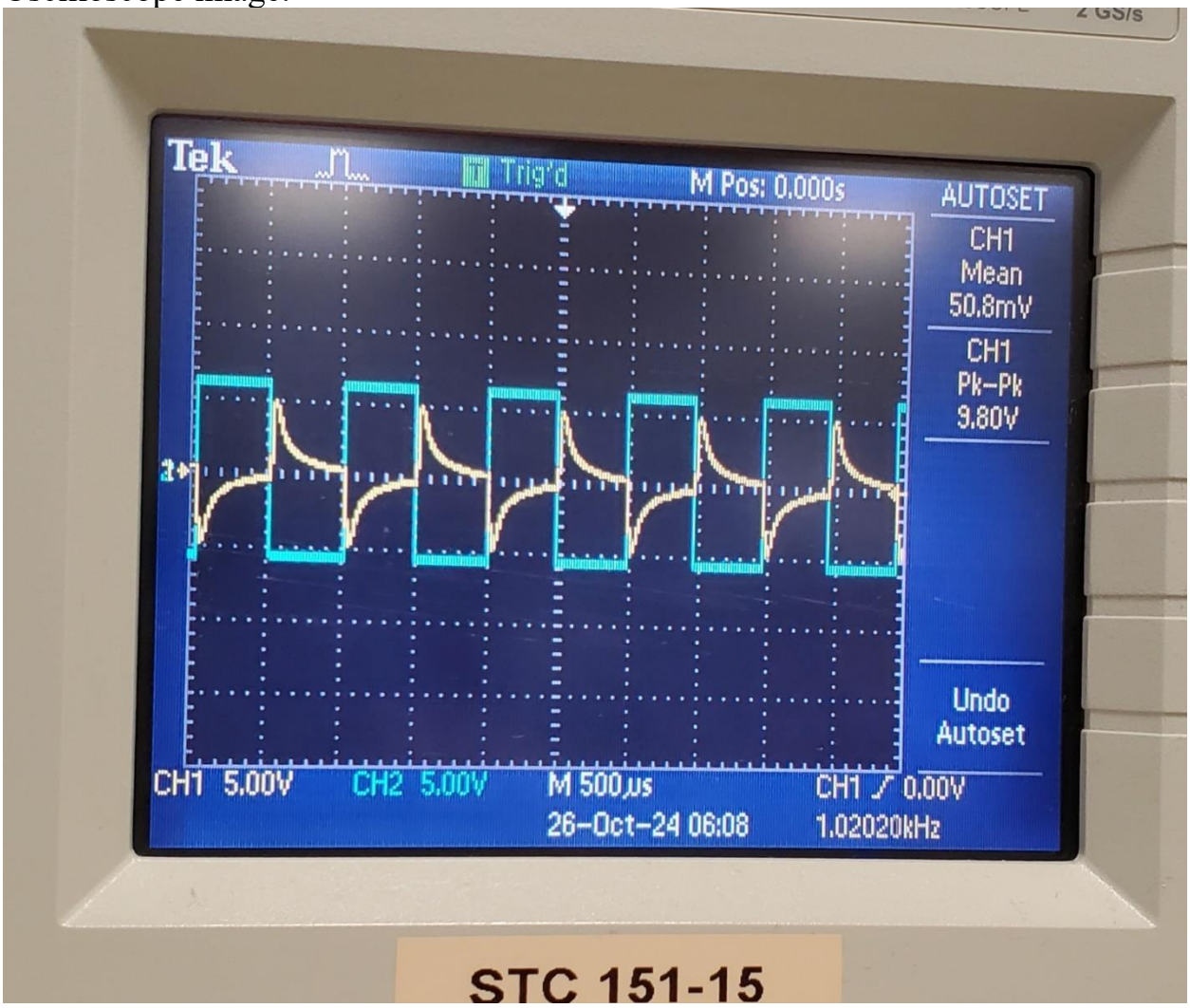
Construct the circuit of Part 1a and make the same measurements using lab equipment. T1 (the red transformer) has a 1:1 turns ratio, so the primary and secondary inductances match each other, but where are the dots????

Oscilloscope image:



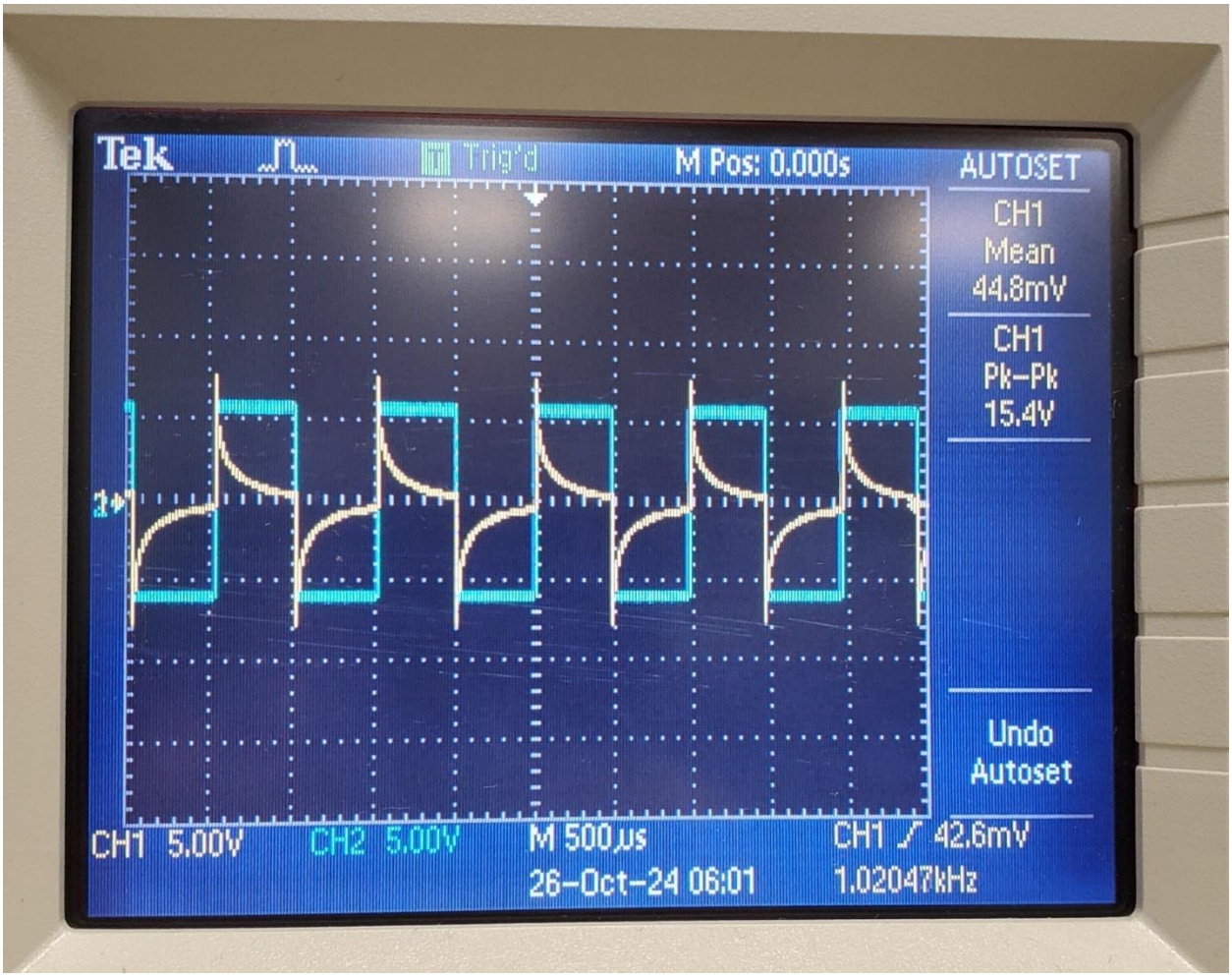
Construct the circuit of Part 1b and make the same measurements using lab equipment.

Oscilloscope image:



Construct the circuit of Part 2a and make the same measurements using lab equipment.

Oscilloscope image:



Construct the circuit of Part 2b and make the same measurements using lab equipment.

Oscilloscope image:

Conclusions (write a conclusion statement that discusses each of the purposes of the lab):

In this lab, we learned how to simulate magnetically coupled inductors which really helped me understand better how inductors both magnetically coupled or adding/subtracting from each other behave and affect voltages. Using the oscilloscope and function generator, we were able to evaluate the magnetically coupled windings of a transformer which showed the same things as our simulations and see how much magnetic coupling between inductors changes voltage within the circuit.